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Design and Implementation of Handheld Museum Guide

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Abstract- Many applications have been available in the market for guiding tourists in museums for helping them reaching their destinations efficiently. But these applications suffer from many shortcomings including limited functionality and accuracy of features. To alleviate these problems, we propose a design and implementation of TIG handheld museum tour guide device. TIG has been designed to provide the museum tourists with accurate and reliable information along with the ability to Interactive with free move. In addition to providing general information, TIG is capable of making visitor surveys with friendly GUI. Also, this device has been designed to access huge database. Evaluation of the device shows that TIG provides more accurate information with better efficiency than the existing solutions.

***Index Terms*-** Handheld Device, Museum Tour Guide, friendly GUI.

I. INTRODUCTION

When we come into a museum, there are usually some kinds of guide systems, such as traditional multilingual tour expositor, special sections for expertise explanations, touch-screen computers for inquiries and tape or CD guide machine. All of them seem to bear different kinds of problems. Traditional multilingual tour guide and special sections for expertise explanations require high expense on training and ages. Touch-screen computers for inquiries provide the interaction with the user, but they cannot be carried around. As to tape or CD, which seems to be cheaper and easier to catch, it lacks the function of interaction. Visitors interested in the exhibit can press the indexed number of the exhibit and listen with the earphone, but they may not be able to enjoy color pictures functional and suitable to be applied for multimedia applications. With what have been stated, we choose handheld devices in museum guide system.

RFID is used to navigate and get the index number of exhibit. Every exhibit owns a RFID tag and RFID reader obtains the information in RFID tag such as index number of exhibit. System deployed on handheld devices gets detailed information from database through wireless network. Visitors can listen to the audio explanation, watch video, look the color picture of the exhibited items and read the text from the handheld devices without following the pace and route of the expositor. They will have enough time memorizing information explained and enjoy their tour. They will also be able to save their favorite information onto devices, so that they can search for the information about the exhibit without going to the place.

Our guide system will make full use of the exhibits information, including pictures, 3D models, audios, videos, flash, text explanation, coming from our Digital Museum system. There are still issues to consider. How can we use the existing resources and existing services and how to provide the services to other systems which need them? How can we fully utilize the limited multimedia data to make the visitors enjoy themselves? How to design good experiences?

In this paper, we will present a framework and discuss the key technologies of museum guide system based on RFID & handheld device. The rest of the paper is organized as follows. Section 2 reviews the related works. Section 3 describes the hardware and software design of the handheld museum guide system. The system operation will introduce in Section 4. Section 5 shows the implementation of the device. Section 6 concludes this paper and gives the future work.

II. RELATED WORKS

Self-service guides are a common way of providing information about artworks exhibited in museums. Handheld devices are becoming popular companions that support our daily life. Due to increased storage and improved speed, handheld devices can provide multiple functions, such as tour guides, search instruments, and entertainment tools. handheld devices become an inseparable part of the ‘‘digital life’’ for many people around the world. This is owing to the fact that handheld devices have small screens [1], so they can be used at any time and any places. Furthermore, handheld devices permit the delivery of a range of multimedia material, such as audio, graphics, and video. In spite of such benefits, handheld devices are not expensive when compared with other types of computers [2]. Modern advances in handheld applications and wearable devices that offer new ways of designing museum guides that are more engaging and interactive than traditional self-service guides such as written descriptions or audio guides as in [3], [4].

Researchers design many systems for guiding such as iGuider (Intelligent-Guider), which is based on user-centered design principles and in view of usability and user experience perspective. iGuider uses the ARM11 processor and embedded systems, integrates Geographic Information System (GIS), multichannel interaction technologies and RFID to provide multimedia attraction information for tourists as in [5]. Researchers design the tour guide system to be a humane and intelligent portable instrument guide [6][7]. As to the position technology about which exhibit you are looking for, [8] uses the infrared transmission technology to automatically get the position of the visitor. A Museum Guide System which is based on handheld devices (e.g. PDAs, short for Personal Digital Assistants) is presented in [9]. In which Radio-frequency identification (RFID) is used to navigate and get the index number of exhibit. Compared to traditional guide systems, such as tape or CD guide machine.

III. SYSTEM DESIGN

A. Block Diagram

As shown in figure 1, the proposed hardware design of the handheld device mainly consists of Raspberry Pi 3 controller, Radio Frequency Identification Reader (RFID Reader), touch screen, and Microphone and speaker.

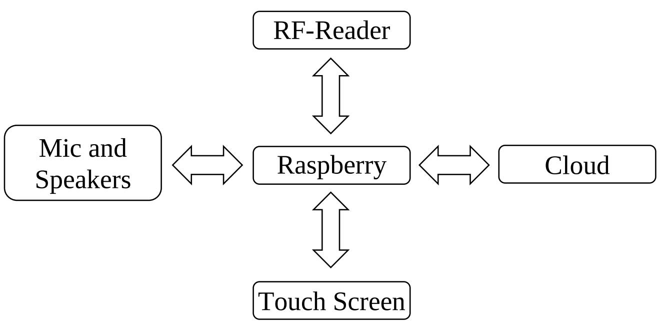

Figure 1: Block Diagram of Tour Guide Handheld Device

B. Hardware Design

- Controller (Raspberry Pi 3 Model B)

The Raspberry Pi 3 Model B shown in figure 2 is the third generation Raspberry Pi. This powerful credit-card sized single board computer wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

Figure 2: Raspberry Pi 3 Model B

- Radio Frequency Identification Reader (RFID Reader)

A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. RFID shown in figure 3.

Figure 3: Radio Frequency Identification Reader

- Raspberry pi screen

We use Raspberry Pi 5 inch HDMI LCD USB TFT (800 x 480) display with touch screen that can provide high resolution picture and large viewing screen for the Raspberry Pi.

C. Software

- Raspbian OS

Raspbian comes out on top as being the most user-friendly, best-looking, has the best range of default software's and optimized for the Raspberry Pi hardware.

- Software Code

I. Python

Python is a widely used general-purpose, high level programming language. It was mainly developed for emphasis on code readability, and its syntax allows programmers to express concepts in fewer lines of code.

II. Tkinter

Tkinter is Python's de-facto standard GUI (Graphical User Interface) package. It is a thin object-oriented layer on top of python layer. Tkinter is not the only GUI programming toolkit for Python. It is however the most commonly used one.

III. SPI protocol

Implementation of SPI driver by python The Serial Peripheral Interface bus (SPI) is a synchronous serial communication interface specification used for short distance communication, primarily in embedded systems. SPI devices communicate in full duplex mode using master-slave architecture with a single master.

- Text to Speech (Alexa)

Alexa Voice Service (AVS) is Amazon's suite of services built around its voice-controlled AI assistant for the home and other environments. AVS enables voice interaction with various systems in the environment and online. Alexa also supports an online service that automates Web-based tasks so that when user-specified events occur, follow-up tasks are triggered and handled.

D. Overview of the Operation of the System

The Raspberry Pi is the controller of the device; it runs the operating system and displays it on the screen. The RF-Reader is used to localize the device in the map and find the status around it. The Headphones are used to hear the audio scripts, and the mic is used when the user want to ask questions. The Raspberry Pi is connected to IBM cloud at which all the data are collected and analyzed. These data can be accessed through the cloud dashboard.

IV. DESIGNING GUI FOR HANDHELD DEVICE

The system GUI consists of four main screens, The Home Screen, the Map Screen, the statue screen and the Survey screen.

In the Home screen shown in Figure 4, there are three Buttons. The Help Button: In which the user can find a simple manual for how to use the system. The Map Button: This will show the map of the museum and the status in it. The About Button: It contains information about the device version and developers contacts.

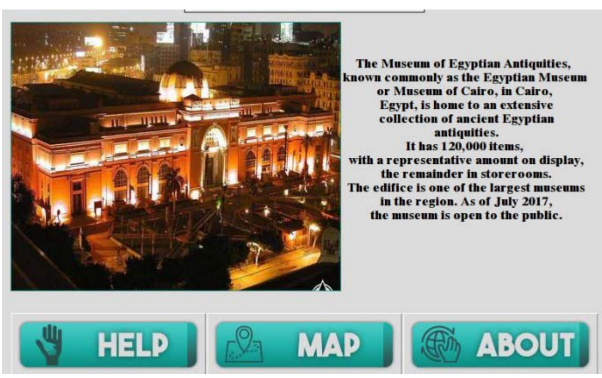

Figure 4: Home Screen

Figure 5 shows the Map screen in which the tourist has three choices to use to design his tour. He can follow a tour based on the nearest status to his location where all the status nearby will be shown on the map and their location so he can choose one of them. Or based on the Trending Status where the most visited and the most popular status will be shown on the map. Finally, He can display all status in the museum in case he wants to find specific statue.

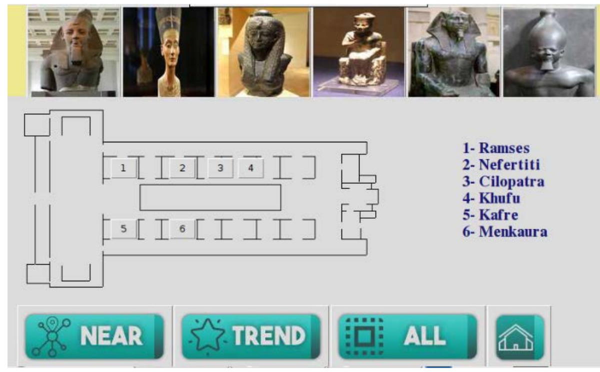

Figure 5: Map Screen

Once the tourist will choose a statue, the Statue screen will open and some information about the statue will be shown on the screen as well as the information will be heard through the headphones. The tourist can pause/play, stop and start the script again. As well, he can show more information about that statue, ask question about that statue or go back to find another statue. The statue screen is shown in Figure 6.

Figure 6: Statue Screen

After some time, the survey screen pops up to the tourist that asks him some questions about his tour in the museum, his visit to the country, some personal questions and to rate the device.

Beside the data from the survey, the device also collect data about what status do the tourist visit and how long he consumes at each of them. All these data are shown on a dashboard which can be used to improve the tourist visit to the museum by changing the most visited status positions so they can be reached easier, rearrange the status at which the tourist consume long time in order to reduce the crowding and update the status information based on the asked questions.

Finding statistics about the tourists as what nationalities visit the country, what are target gender and age. This information can be used in marketing.

V. System Flowchart

The user communicates with the handheld device through touch screen. At the beginning of the tour there is a welcome massage after that a screen that contain the help icon which is used to get familiar with the device also there is a map icon used to know the map of museum that can make the tourist made the navigate accurate with himself. When there is status nearby the RFID read detect the status tag and the record of the history of the status start with pictures after the record end there are tour interactive button at which the tourist can ask question by using Alexa and the device will answer it by the information that stored pervious in its data base (Alexa database). If the question is general Alexa will search over Wikipedia and answer the question. Then start to navigate into another status and so on. All the data collected from the RF tags and surveys made in the GUI send to IBM Blue mix cloud to make a dashboard illustrate the number of tourist came to museum and the gender percentage and the nationality needed to market. And used also for dynamic navigation at which the readied tags will send that how many devices nearby the status to alert the other devices to tell the tourist which status is busy and which is not. Figure 7 shows the system flowchart

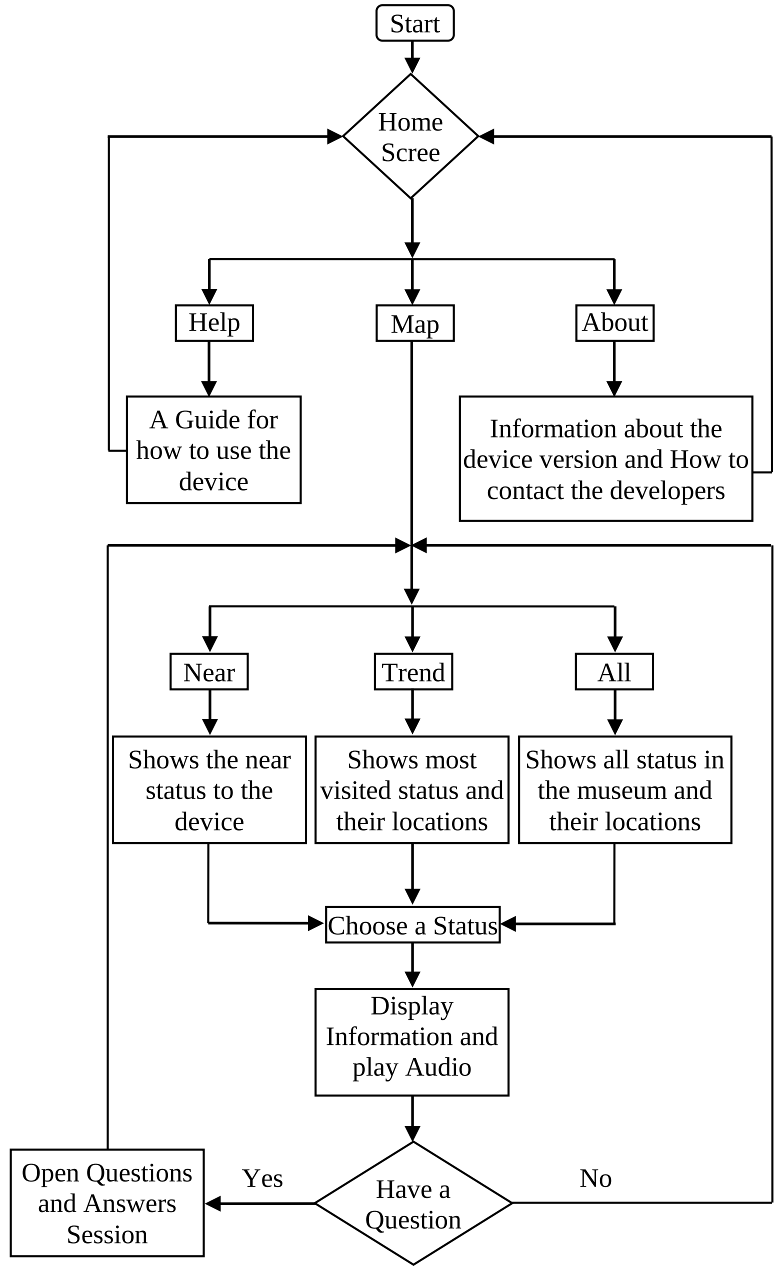

Figure 7: System Flowchart

VI. Results

The experiment investigated the use of handheld device as platforms for self-service museum guides. Five main topics were considered for evaluation: engagement, guidance, interaction & intuitiveness, gamification, and the overall satisfaction. For the engagement, responses from participants of the experiment showed that the handheld tour guide was more engaging than other existing tools, and participants were able to experience the exhibit, rather than just visit it. The participants saw the handheld device more applicable, accessible, and finished, but admitted that the smart phones could have potential in the near future. The handheld device was evaluated as better by participants in the experiment in terms of guidance and interaction & intuitiveness. This has been due to the suitable size of field of view as was also mentioned by the exhibition coordinator. Furthermore, the touchpad of the handheld device seemed more challenging and bigger than interaction through touch on the other self-service museum guides. Further research is needed to develop better interaction, for example, by use of natural hand gestures. Gamification added to the guide did not provide a significantly different experience, but engaged participants in the exhibit. Several participants were very excited to try it out and it showed to be a good way of involving them into the exhibits. Rating on the overall satisfaction with the handheld device did not show any significant notes, and participants would use handheld device if they were available in the museum.

VII. Conclusion

In this paper, we have presented a design and implementation of handheld device for Museum Guide. Figure 8 shows the museum guide device. Many key technologies have been discussed such as localization, Tkinter and Alexa. In spite of the works we have done, some problems have not been solved completely. For example, RFID reader range and power consumption.

VIII. Recommendations

Future studies should replace the Raspberry Pi with a micro controller chip and replace the screen with another one that consume less power in order to increase the power efficiency.

Figure 8: The Museum Guide Device

IX. References

[1] Jonsson, Nass, "Mixing personal computer and handheld interfaces and devices: effects on perceptions and attitudes", International Journal of Human-Computer Studies, Volume 61, Issue 1, July 2004, Pages 71-83.

[2] Allan, Carbonaro, Buck, Allan, C., Carbonaro, et al, "A survey of personal digital assistants (PDAs) use in a middle school environment: Perceptions of teachers, parents and students", Meridian Middle School Computer Technologies Journal, 2006.

[3] Sule Serubugo, Denisa ˇSkant´arov´a, et al," Comparison of Wearable Optical See - through and Handheld Devices as Platform for an Augmented Reality Museum Guide", 12th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2017), pages 179-186, 2017.

[4] Chen-Wei Hsieh, Sherry Y. Chen, "A Cognitive Style Perspective to Handheld Devices: Customization vs. Personalization", International Review of Research in Open and Distributed Learning Volume 17, Number 1, January 2016.

[5] Xinling Wanga, Chengzhang Hanb "Design and Implementation of an Intelligent Tourist Guide System", 4th International Conference on Electrical & Electronics Engineering and Computer Science (ICEEECS 2016) volume 50, 2016.

[6] Zhao Ji, Zhang Xuedong, "Design and Implementation of a Handheld Electronic Tour Guide System", Journal of University of Science and Technology Liaoning. vol. 2006 29(4) 381-384, 2006.

[7] Owaied H H, Farhan H A, Alhawamdeh N, et al, "A model for intelligent tourism guide system", Journal of Applied Sciences, vol. 2011 11(2) 342-347, 2011.

[8] Li-Der Chou, Chia-Hsieh Wu, et al "Requirement Analysis and Implementation of Palm-Based Multimedia Museum Guide Systems". AINA (1) 2004: 352-357.

[9] Yafang Wang, Chenglei Yang, et al "A RFID & Handheld Device-Based Museum Guide System", 2nd International Conference on Pervasive Computing and Applications, 2007. ICPCA 2007.